

PATENT SPECIFICATION



Application Date: June 25, 1941. No. 7992/41.

549,250

Complete Specification Left: July 27, 1942.

Complete Specification Accepted: Nov. 12, 1942.

PROVISIONAL SPECIFICATION

Improvements relating to Revolving Mixing Apparatus and to Processes carried out therewith

I, HENRY PETER BAYON, a British subject, of King's Farm, Little Shelford, in the County of Cambridge, do hereby declare the nature of this invention to be as follows:—

This invention relates to revolving mixing apparatus and to processes carried out with the use of such apparatus. It is the principal object of the invention to provide a mixing apparatus which can be evacuated and will also withstand a certain amount of internal pressure, while the mixing operations in it can be effected over a wide range of relative speeds of the mixing elements, and can produce in a short time thorough mixtures of diverse materials or reagents. The apparatus may be jacketed or provided with heating means and also with connections whereby chemical agents or ingredients of the mixture can be injected at any stage, while the apparatus is in operation; the temperature of the material being mixed has generally to be kept substantially uniform throughout the mass.

A feature of the invention is the provision of a cradle carrying the mixer whereby it is supported while rotating but can be turned to up-end it for convenience in charging and discharging, the cradle also being capable of being rocked or rotated on its trunnions so that the mixer can be rocked or turned endwise as well as being rotated axially.

In one construction in accordance with the invention stanchions implanted in cement on the floor support a frame and carry the cradle for tilting the mixer, even when moving, for the purpose of filling and emptying. This frame or cradle preferably has at least two metal rings carrying rollers in which the jacketed mixing chamber can rotate. The rollers bear upon circular rail tracks surrounding the mixing drum and are flanged so that they will still support the drum when the cradle is tipped for charging and discharging the drum.

The drum itself is a jacketed container adapted to be heated by steam and provided with a blow-off cock for condensed moisture. A hollow shaft extends through

the drum and is mounted to rotate therein; it may be plugged near one end so that it can be used for admission of steam to the jacket through one end and for admission of reagents or ingredients to the interior of the drum through the other end. Alternatively, a separate steam admission box may be provided at one end of the drum communicating by a bent pipe with the jacket and centred by a steady pin at the end of the hollow shaft, so as to allow for rotation. If the hollow shaft is used for steam admission it has perforations in it within a gland in the end wall of the drum communicating with passages whereby the steam is conveyed to the jacket surrounding the drum wall.

The steam may be admitted through a swivelling pipe connection at the axis of the cradle, and thence through a pipe leading to a gland or steam box coaxial with the hollow shaft, and so to the drum. In this case the steam connection will not need to be broken each time that the cradle is rocked or is tilted. As no high steam pressure is normally required, however, a steam connection which can be made and opened out at one end of the drum will suffice for many purposes.

If it is desired to provide for the injection of vapours or gases while the drum is in rotation, a connection for this purpose may be made to one end of the hollow shaft, and the vessel for supplying the gas or vapour may be carried by the cradle. A cylinder of compressed gas may be used, or an electrically heated vessel for supplying the gas in a heated condition, the vessel being connected by a pipe and gland with the hollow shaft. Alternatively, the supply vessel may be fixed, so as to save moving weight, and the connection may be made through a swivel coupling in the axial line of the cradle, and so to the drum.

The shaft passing through the drum carries mixing blades which may be radial arms or paddle blades of any form and may intermesh with blades or projections on the interior of the drum wall if desired, although this is not generally necessary, and it is preferable for the drum to have

[Price 1/-]

AMENDMENT - SEE LAST PAGE

a smooth internal surface. The blades may be in the form of bent tubes with passages in them communicating with the hollow shaft, and with perforations in the tubes through which a gas or liquid may be admitted to the interior of the drum. For most purposes, however, simple stirring or mixing blades will suffice, the reagents being admitted through perforations in the length of the hollow shaft. These perforations may be provided with non-return valves, for example simple spring-controlled ball valves which will only allow flow inwardly and will withstand back pressure.

One or both ends of the drum may be provided with one or more loading man-holes, one or more hinged unloading doors, connections for evacuating the interior of the drum. Other connections for admitting gases under pressure, and sockets for thermometers, pressure gauges and so forth. A convenient arrangement is one in which two circular loading man-holes with removable covers are provided in opposite quadrants at one end, and two hinged unloading doors are provided in the two intermediate quadrants, but a single loading manhole and a single unloading door may suffice for many purposes.

Gears or belt pulleys are provided for driving the central shaft and the drum itself, and also a braking mechanism for applying a drag to the drum when positive drive for this is not required. Any convenient means of transmission may be used, as for example, an electric motor with a reduction gear may be carried on the cradle so as to maintain the drive while the drum is tilted or rocked. If a drive under these conditions is not required, the motor and its reduction gear may be stationary, and a pinion on the hollow shaft may come into mesh with the driving wheel of the speed reduction gear when the cradle is locked in its normal horizontal position. The drive for the drum itself may be transmitted from the same electric motor through the same or a further reduction gear, and it may be applied to one or more of the shafts carrying the sets of rollers on which the drum turns. If a belt drive is preferred, open and crossed belts may be provided with fast and loose pulleys and reversing levers, whereby the direction of drive may be reversed when required.

For tilting the cradle a worm wheel may be provided on one axle of the cradle actuated by means of a worm and hand wheel, or by a power drive if a continual rocking movement is desired.

In the normal operation of this apparatus it may be required to evacuate the

drum and to evaporate and extract volatile material from the charge therein, then to inject a reagent under pressure and subsequently to relieve any pressure which builds up within the drum, and to collect for use gaseous products evolved. The material in the drum may need stirring or mixing at various speeds during its treatment, and when relatively slow mixing is required, as for example during starting up, the drum and shaft may be allowed to rotate together, the brake being applied to the drum or to a member in driving connection with it to check its rotation and to increase the relative speed of movement. Then if a still faster mixing speed is desired, the drum may be driven positively in the opposite direction to the hollow shaft which carries the mixing arms or blades.

One use of the apparatus according to the invention is in the treatment of materials such as waste wood, chips, shavings, sawdust, wood flour and the like for the production of moulded articles therefrom. In using the apparatus for this purpose a charge of wood chips, shavings or the like is introduced through the loading manhole while the cradle is tipped to up-end the drum; the manhole is then closed and its cover clamped down. Steam will have been admitted in advance to the jacket to heat the drum up to a temperature of say 70° C. or whatever is required. It is necessary now to extract moisture from the material, and for this purpose an exhausting connection is made at one end of the drum. It is not generally necessary to rotate the drum while it is being exhausted so that a rotary gland fitting is not required, but it can be provided if necessary for any purpose. The exhausting connection may lead direct to a vacuum pump, but as the woody matter gives off chemical substances when heated under reduced pressure, and these chemical substances are liable to damage or clog the vacuum pump, it is preferable to use two exhausting tanks to which the vacuum pump is connected in turn, and to connect the tanks alternately with the exhausting connection to the drum. Then the chemical reagents which pass out from the drum into the tanks can be allowed to cool and deposit therein and can be removed or washed out if necessary before the next exhausting operation. It is possible by such means to extract moisture and chemical substances from the wood at a rapid rate so that a reduced pressure of the order of from one-fifth to one-tenth of an atmosphere is obtained in a quarter of an hour or twenty minutes. It may be desirable to disconnect the exhausters, to rotate the mixer for a short

time, and to effect a further stage of exhaustion after this.

When the exhausting operation has been carried far enough, and the vacuum does not tend to fall rapidly, the exhaust-
 5 next stage in the process can be carried out. This consists in injecting a heated reagent such as
 10 cresylic acid or xylol under pressure through the non-return opening in the hollow shaft. The injection is effected while the mixer is rotating so that the reagent is evenly distributed throughout
 15 the mass. At first the mixer shaft and the drum may rotate in the same direction and then the brake may be applied to the drum to slow it down so as to increase the relative mixing speed and ultimately a
 20 still higher mixing speed is obtained by driving the drum in the opposite direction. The injected material reacts with the wood or the like while impregnating it, and products of reaction consisting of steam
 25 and organic chemical substances are evolved which rapidly raise the pressure in the drum. The pressure vapours and gases are blown off either continuously through a controlled safety valve or at
 30 intervals by opening a cock, the products being preferably collected because they contain valuable chemical substances. In the particular treatment consisting of impregnating wood with a reagent such
 35 as cresylic acid or xylol the pressure will not generally be allowed to rise above 15 lbs. per square inch beyond atmo-

spheric, although it is easy to build the jacketed mixer to stand a higher pressure if necessary. When the treatment is
 40 complete the cradle is turned again to up-end the drum, and the product is removed through one or more hinged unloading doors, which open near the circumference
 45 of the drum so as to facilitate the complete discharge of the contents.

In addition to treating the woody matter with a reagent such as cresylic acid or xylol, a synthetic resin in fluid condition
 50 may be injected for mixing with the treated wood in which case a plastic mass is produced in the drum suitable for rolling out into sheet form and moulding by heat and pressure. It may be preferable,
 55 however, to effect the mixing with the synthetic resin in a separate mixer in order to avoid clogging the rotary high speed mixer with solidifying resinous matter.

The invention is not limited to the use
 60 of the apparatus for the particular purpose mentioned above, but this is given by way of example. The rotary mixer is usable for any purpose in which a jacketed mixer
 65 running at a considerable variety of mixing speeds is needed, and particularly in cases where evacuation of vapourisable constituents from the interior of the drum is desirable at any stage in the treatment.

Dated this 25th day of June, 1941.

For the Applicant:

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 Chartered Patent Agents,
 51/52, Chancery Lane, London, W.C.2.

COMPLETE SPECIFICATION

Improvements relating to Revolving Mixing Apparatus and to Processes carried out therewith

70 I, HENRY PETER BAYON, a British subject, of King's Farm, Little Shelford, in the County of Cambridge, do hereby declare the nature of this invention and in what manner the same is to be per-
 75 formed, to be particularly described and ascertained in and by the following statement:—

This invention relates to revolving mixing apparatus and to processes carried
 80 out with the use of such apparatus. It is the principal object of the invention to provide a mixing apparatus which can be evacuated and will also withstand a certain amount of internal pressure, while the
 85 mixing operations in it can be effected over a wide range of relative speeds of the mixing elements, and can produce in a short time thorough mixtures of diverse materials or reagents. The apparatus
 90 may be jacketed or provided with heating

means and also with connections whereby chemical agents or ingredients of the mixture can be injected at any stage, while the apparatus is in operation; the tempera-
 95 ture of the material being mixed has generally to be kept substantially uniform throughout the mass.

A feature of the invention is the provision of a cradle carrying the mixer whereby it is supported while rotating but
 100 can be turned to up-end it for convenience in charging and discharging or for other purposes, the cradle also being capable of being rocked or rotated on its trunnions so that the mixer can be rocked or turned
 105 endwise as well as being rotated axially.

The invention also includes the method of using the mixer for the treatment of materials such as wood waste, chips, shavings and sawdust for the purpose of
 110 extracting moisture therefrom, and im-

pregnating them with reagents which may subsequently form part of the treated product, or may take part in the formation of artificial resins with which the woody matter is to be combined to make composite sheets, panels and so forth.

One construction of the mixer according to the invention is illustrated in the accompanying drawings wherein:—

Figure 1 shows the mixing drum in longitudinal section;

Figure 2 shows the mixer and its cradle in side elevation;

Figures 3 and 4 are end elevations, the one showing the mixer from the driving end, and the other showing the charging and discharging doors and connections at the other end of the drum.

Referring to the drawings, the mixer consists of a jacketed drum 5 revolvably mounted in a cradle 6 which is carried on uprights 7 by means of trunnions 8. The cradle can be tilted about the axis of these trunnions by means of a worm wheel 9 meshing with a worm 10 supported on one of the uprights 7 and turned by means of a handle 11 or otherwise.

The drum is provided with rings 12 by which it is supported upon rollers 13 on spindles 14 carried by the cradle 6 so that the drum can rotate freely in the cradle while the cradle itself can be tilted on its trunnions when required. The rollers 13 are flanged to engage at each side with the rings 12 so as to support the drum longitudinally when tilted.

The drum has a shaft 15 extending through it and adapted to turn in glands 16 and 17 which permit relative rotation between the shaft and the drum while resisting the entry or escape of gases when the interior of the drum is evacuated or under pressure respectively. For driving the drum any convenient means may be provided. In this case an electric motor 18 is shown carried by a bracket 19 on the cradle, the pulley 20 of this motor driving the shaft 15 through a fast pulley 21, beside which is a loose pulley 22 on to which the belt can be shifted when the drive is to be stopped. The shaft 15 also carries at its end a pulley 23 connected by a further belt which drives either the fast pulley 24 or the loose pulley 25 on one of the shafts 14 of the cradle on which the drum is carried by the rollers 13. The drive of course can be transmitted to two or more of the shafts 14 if desired, but it generally suffices to drive one of them for rotating the drum in the cradle. Any other means may be adopted for driving the drum and its shaft, each by a separate motor if preferred for example, and the belt drive illustrated is indicated only as one convenient arrangement. The elec-

tric power for the motor 18 is conveyed by flexible leads, not shown, so as to permit of the tilting movements of the cradle. The weight of the electric motor and pulley drive mechanism can be counter-balanced by weights at the other end of the cradle if desired so as to make it easier to tilt the cradle by hand. A brake is provided at 26 on one end of the driven shaft 14 whereby the drum can be held against rotation or allowed to rotate under the drag of the materials moving within it under the action of the shaft and its impeller.

The shaft 15 carries suitable blade impellers 27 which will stir up the material in the drum as the shaft rotates, and will preferably tend to push it inwardly towards the centre so as to prevent it from piling up at the ends. The shaft 15 is hollow and has a gland 28 at one end to receive a pipe 29 communicating with one end of the hollow shaft. This pipe is carried through the cradle to one of the trunnions 8 and is connected by a further gland in that trunnion to an external stationary pipe 30 connecting with a tank 31 or other source of liquid or gas to be introduced into the drum. The hollow shaft has a number of apertures controlled by ball valves 32 or other non-return valves whereby the fluid introduced through the pipe 29 can escape through the hollow shaft into the interior of the drum while the return of material from the drum through the hollow shaft is prevented.

The drum is made with a steam jacket in its cylindrical wall and in its ends, as seen in Figure 1, where a projecting fitting with a cock 33 is shown for introduction of the steam to the jacket, while at the other end a drain cock 34 is shown for running off condensed water from time to time as may be required. With this arrangement the steam connection can only be made while the drum is stationary, and it has to be disconnected when the drum is to be allowed to rotate. This is generally sufficient because once the drum has been heated up to the required temperature together with its contents it remains at that temperature for a considerable time, generally long enough for the operations which has to be carried out while the drum rotates. If preferred, however, the steam could obviously be admitted through a pipe in the other trunnion 8 connected to a pipe leading into the jacket from the cradle, for example through the end opposite to that at which the pipe 29 is connected, whereby the admission of steam could be continued in all positions of the drum.

For the purpose of giving access to the

interior of the drum, one end of it is provided with one or more loading manholes 35 and one or more hinging discharging doors 36, as best seen in Figure 4. This end of the drum may also carry any other fittings, such as a pressure gauge 37, an evacuating connection 38, a thermometer 39, and a blow-off valve 40. These are only mentioned by way of example.

The interior of the drum 5 may have projections to engage with and turn over the material in the drum as it rotates or to co-operate with the blades 27 in mixing the material, but this is not generally necessary. Although a motor 18 driving the shaft 15 and drum 5 through simple belt transmission has been shown, of course a speed reduction gear may be included in the drive, and a gear-wheel train may be used for driving in place of belts. It is assumed that the motor 18 is of a type which can be reversed in order to reverse the direction of drive of the shaft 15 and drum 5, but open and crossed belt drives may be used in the well known manner for reversal if required, or any usual type of reversing transmission. The brake 26 may be applied directly to the drum itself instead of being applied to the shaft 14 as shown, and many other details in the apparatus may be modified to suit particular conditions. The blades 27 may be hollow and reagents from the hollow shaft 15 may pass into the blades and out through non-return valves on the blades themselves, but that is not generally necessary.

In the normal operation of this apparatus it may be required to evacuate the drum 5 and to evaporate and extract volatile material from the charge therein, then to inject a reagent under pressure through the pipe 29, the hollow shaft 15 and non-return valves 32, and subsequently to relieve any pressure which builds up within the drum, and to collect for use gaseous products evolved, for example by an exhausting pump connected to the vacuum fitting 38 on the end of the drum. The material in the drum may need stirring or mixing at various speeds during its treatment, and when relatively slow mixing is required, as for example during starting up, the drum 5 and shaft 15 may be allowed to rotate together by the drag of the material in the drum, the brake 26 being applied when required to check the rotation of the drum and to increase the relative speed of movement. Then, if a still faster mixing speed is desired, the drum 5 may be driven positively in the opposite direction to the hollow shaft 15 through the transmission 23, 24, shaft 14 and rollers 13 thereon.

One use of the apparatus according to

the invention is in the treatment of materials such as waste wood, chips, shavings, sawdust, wood flour and the like for the production of moulded articles therefrom. In using the apparatus for this purpose a charge of wood chips, shavings or the like is introduced through the loading manholes 35 while the cradle 6 is tipped to up-end the drum; the manholes are then closed and their covers clamped down. Steam will have been admitted in advance to the jacket to heat the drum 5 upto a temperature of say 70° C. or whatever is required. The drum can be tilted back and forth if required by the gear 9, 10, 11 acting on the cradle, to distribute the material evenly in the drum. It is necessary now to extract moisture from the material, and for this purpose an exhausting connection is made to the drum at 38. It is not generally necessary to rotate the drum 5 while it is being exhausted so that a rotary gland fitting is not required, but it can be provided if necessary for any purpose. The shaft 15, with its blades 27 can, of course, be turned during the exhausting operation. The exhausting connection 38 may lead direct to a vacuum pump, but as the woody matter gives off chemical substances when heated under reduced pressure, and these chemical substances are liable to damage or clog the vacuum pump, it is preferable to use two exhausting tanks to which the vacuum pump is connected in turn, and to connect the tanks alternately with the exhausting connection 38. Then the chemical reagents which pass out from the drum into the tanks can be allowed to cool and deposit therein and can be removed or washed out if necessary before the next exhausting operation. It is possible by such means to extract moisture and chemical substances from the wood at a rapid rate so that a reduced pressure of the order of from one-fifth to one-tenth of an atmosphere is obtained in a quarter of an hour or twenty minutes. It may be desirable to disconnect the exhaust, to rotate the drum 5 for a short time, and to effect a further stage of exhaustion after this.

When the exhausting operation has been carried far enough, and the vacuum does not tend to fall rapidly, the exhausting connection made at 38 can be removed and the next stage in the process can be carried out. This consists in injecting a heated reagent such as cresylic acid or xylol under pressure through the non-return openings 32 in the hollow shaft. The injection can be effected while the shaft 15 and drum 5 are both rotating so that the reagent is evenly distributed

throughout the mass. At first the shaft 15 and the drum 5 may rotate in the same direction and then the brake 26 may be applied to slow down the drum so as to increase the relative mixing speed, and ultimately a still higher mixing speed is obtained by driving the drum in the opposite direction. The injected material reacts with the wood or the like while impregnating it, and products of reaction consisting of steam and organic chemical substances are evolved which rapidly raise the pressure in the drum. The pressure vapours and gases are blown off either continuously through the connection 38 or through a controlled blow-off valve 40 or at intervals by opening a cock, the products being preferably collected because they contain valuable chemical substances. In the particular treatment consisting of impregnating wood with a reagent such as cresylic acid or xylol the pressure will not generally be allowed to rise beyond 15 lbs. per square inch above atmospheric, although it is easy to build the jacketed mixer to stand a higher pressure if necessary. When the treatment is complete the cradle is turned again to up-end the drum, and the product is removed through the hinged unloading doors 36, which open near the circumference of the drum so as to facilitate the complete discharge of the contents.

After treating the woody matter with reagent such as cresylic acid either alone or mixed with xylol, a synthetic resin of the phenolic or cresylic type in fluid condition or in solution may be injected for mixing with the treated wood, in which case a plastic mass is produced in the drum suitable for rolling out into sheet form and moulding by heat and pressure. It may be preferable, however, to effect the mixing with the synthetic resin in a separate mixer in order to avoid clogging the rotary high speed mixer 5 with solidifying resinous matter. If cresylic acid either alone or mixed with xylol is used for the impregnation it is capable of reacting with ingredients in the wood to form part of the condensation product, so that the impregnation of the woody matter to the required extent by the synthetic resin is facilitated.

The invention is not limited to the use of the apparatus for the particular purpose mentioned above, but this is given by way of example. The rotary mixer is usable for any purpose in which a jacketed mixer running at a considerable variety of mixing speeds is needed, and particularly in cases where injection of fluid reagents or evacuation of vapourisable constituents from the interior of the drum is desirable at any stage in the treatment.

It might be used for example for impregnating grain with liquid ingredients; wheat may be impregnated with cod liver oil.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A rotary mixing apparatus adapted to operate over a considerable range of speeds, comprising a rotary drum and a shaft therein carrying stirring blades, the drum and the shaft being carried by a cradle which can be turned to tilt the drum about a transverse axis, driving means for the shaft and for the drum, and a brake for checking the free rotation of the drum, whereby the drum can be allowed to rotate by the drag of the material therein in the same direction as the shaft and its stirring blades, or can be braked to increase the relative movement, or can be driven in the opposite direction to the shaft.

2. A rotary mixing apparatus comprising a jacketed drum with means for supplying its jacket with a heating fluid such as steam, a cradle supporting the drum in such a way that the drum can be rotated within the cradle, and means for supporting the cradle so that it can be tilted transversely to the axis of the drum, a stirrer within the drum and means for driving it relatively to the drum, connections for supplying reagents to the interior of the drum while it is in operation, and apertures whereby materials may be charged into and removed from the interior of the drum, with means for closing such apertures in a fluid-tight manner.

3. A rotary mixing apparatus according to claim 1 or claim 2, wherein the shaft is hollow for the purpose of admitting reagents and has non-return valves for the discharge of the reagents into the interior of the drum, while connections are provided leading into the hollow shaft and allowing of its rotation relatively to such connections.

4. A rotary mixing apparatus according to claim 3, wherein the connections for supplying fluid reagents to the interior of the drum include a pipe leading to one of the trunnions of the cradle, and a pipe leading from this trunnion to a gland at one end of the hollow shaft, so that the drum can be supplied with reagents in all positions of the cradle and drum.

5. A rotary mixing apparatus according to claim 1 or claim 2, wherein the cradle carries a motor for driving the shaft and the drum, and gearing whereby the shaft only may be rotated, or the drum can also

be rotated in the opposite direction of rotation to the shaft.

6. A method of using the mixing apparatus according to any of the preceding claims for exhausting volatile constituents from natural products such as chips, shavings and sawdust, and impregnating such products with fluid reagents, wherein the products are charged into the drum while the jacket is heated, the interior of the drum is connected to an exhausting system whereby volatile constituents are evaporated and withdrawn from the solid matter, and the shaft and drum are then rotated while fluid reagents are fed into the drum and mixed with its contents.

7. Rotary mixing apparatus according

to any of claims 1 to 5, constructed and adapted to operate substantially as described with reference to the accompanying drawings.

8. The method of using the mixing apparatus of any of claims 1 to 5, and in accordance with claim 6, as applied to woody products which are to be deprived of some of their volatile constituents and then impregnated with fluid reagents, substantially as hereinbefore described.

Dated this 27th day of July, 1942.

For the Applicant:

GILL, JENNINGS & EVERY,

Chartered Patent Agents,

51/52, Chancery Lane, London, W.C.2,

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1942

ERRATA

SPECIFICATION No. 549,250.

Page 2, line 20, *for* "drum. Other"
read "drum, other"

Page 3, line 5, *after* "exhaust" *insert*
"ing connection can be removed and
the"

Page 3, *delete* line 9.

Page 3, line 11, *for* "opening" *read*
"openings"

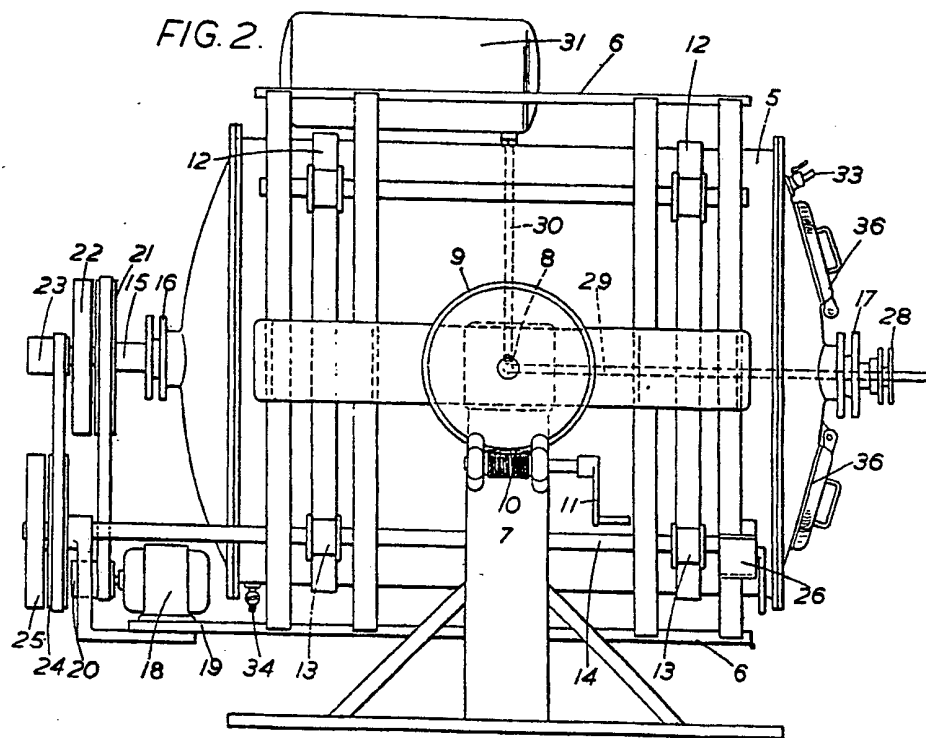
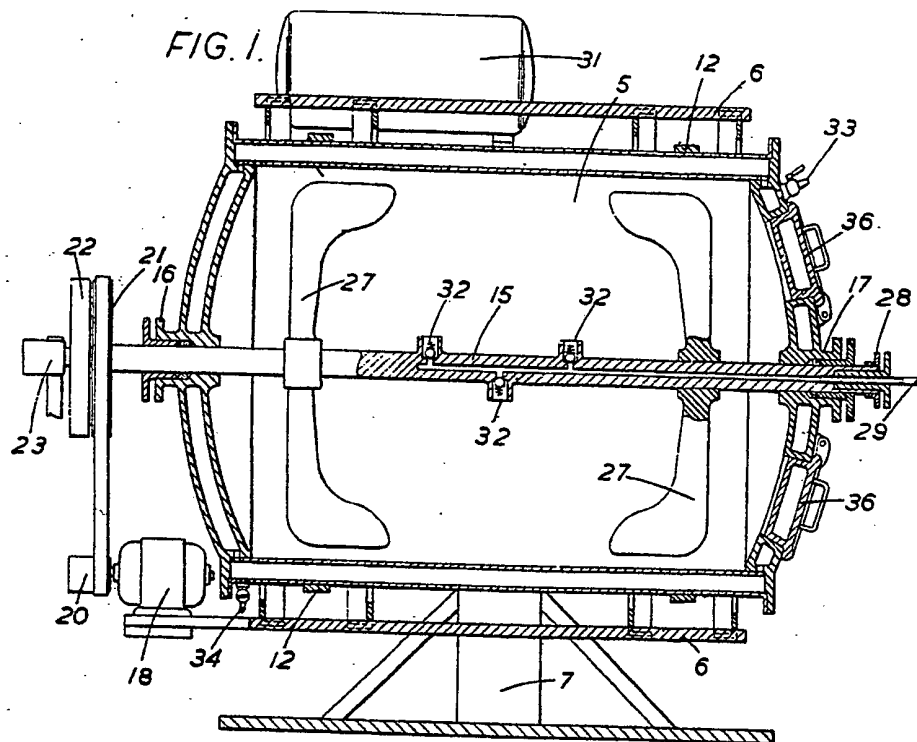
Page 4, line 120, *for* "has" *read*
"have"

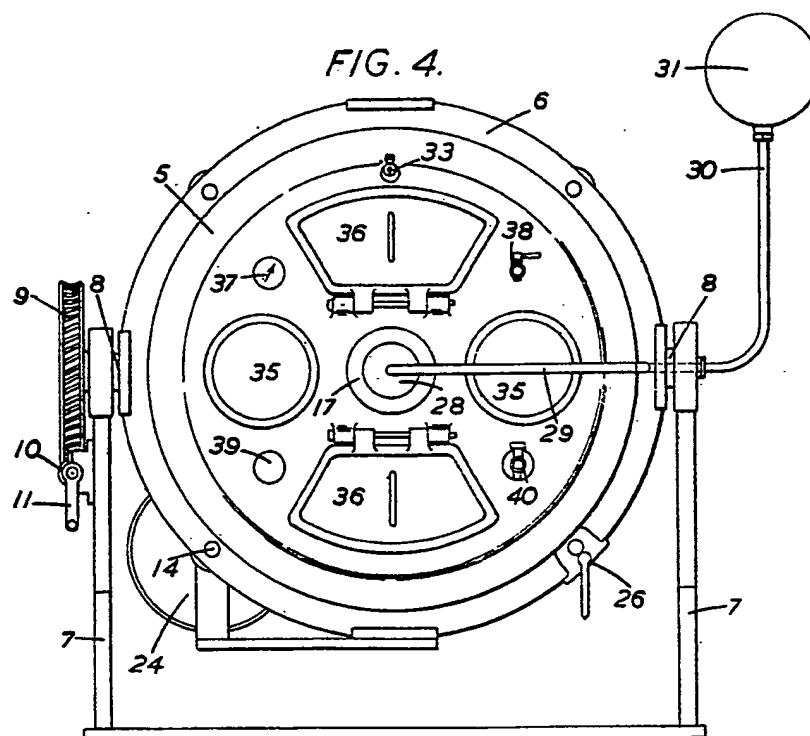
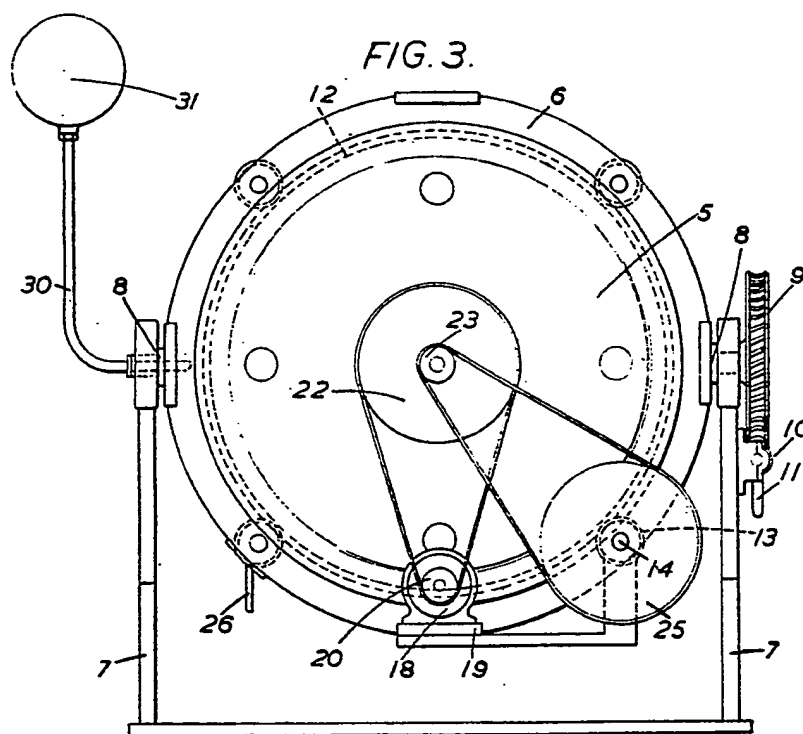
Page 6, line 34, *after* "with" *insert*
"a"

THE PATENT OFFICE,

March 3rd, 1943.

[This Drawing is a reproduction of the Original on a reduced scale.]





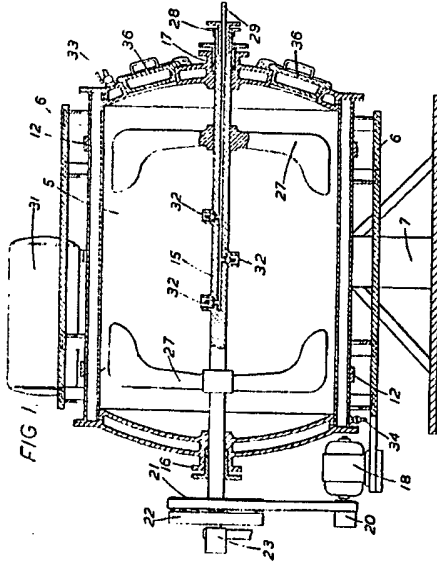


FIG. 1.

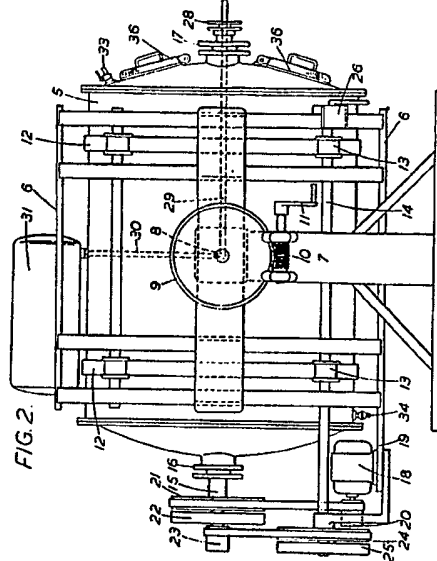


FIG. 2.

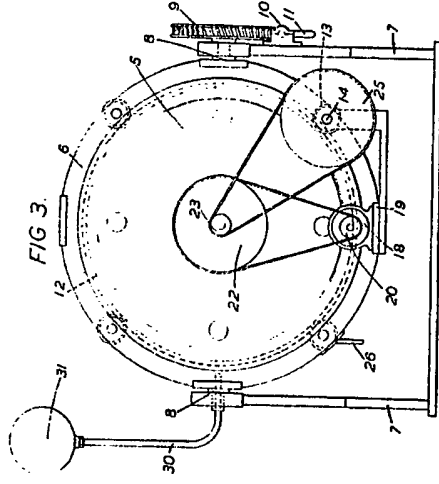


FIG. 3.

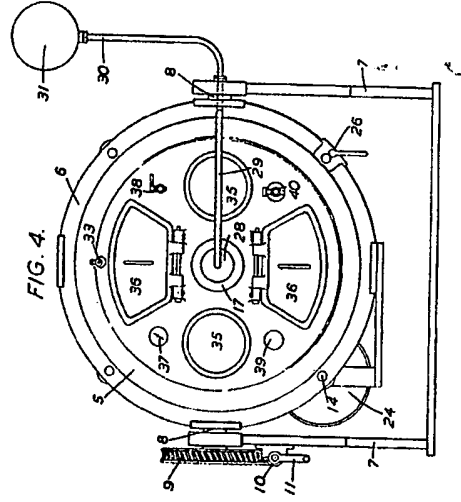


FIG. 4.

[This Drawing is a reproduction of the Original on a reduced scale.]